TEST Friday

- Graphing
- Kinematics
  - "Simple" equation
  - Kinematics equations
- Format
  - Conceptual MC
  - Graphs
  - Problems

Free-fall

- Falling with just gravity
- In the y-direction
- Acceleration is acceleration due to gravity

$$a_g = 9.8\ m/s^2 \text{ down}$$

- Kinematics equations:

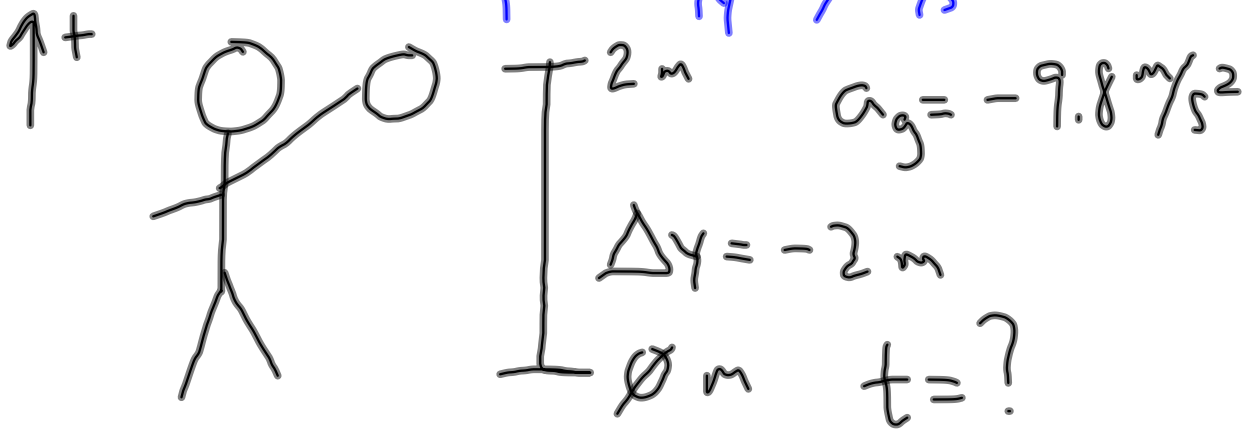
$$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$$

$$v_{fy} = v_{iy} + a_g t$$

$$v_{fy}^2 = v_{iy}^2 + 2 a_g \Delta y$$

Jason drops a volleyball from 2.0 m above the floor. How long will it take before the ball hits the ground?

implies $v_{iy} = 0$ m/s



$$\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$$

$v_{iy} = 0$

$$t = \pm\sqrt{\frac{2\Delta y}{a_g}}$$

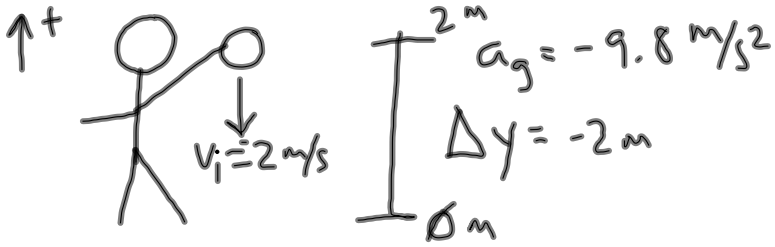
ignore negative answer b/c time is never negative

$$= \sqrt{\frac{2(-2\ m)}{-9.8\ m/s^2}}$$

$$= 0.64\ s$$

always need to have a positive under the radical → no imaginary times

Jason now throws the ball downwards at 2 m/s, again from 2 m.
a) Find the velocity of the volleyball just before it hits the ground.
b) Find the time it took for the ball to travel the 2 m.



a) $v_{fy}^2 = v_{iy}^2 + 2a_g\Delta y$

$v_{fy} = \pm\sqrt{v_{iy}^2 + 2a_g\Delta y}$

$= \pm\sqrt{(-2\text{ m/s})^2 + 2(-9.8\text{ m/s}^2)(-2\text{ m})}$

$= -6.57$ m/s

choose negative because ball is moving downwards

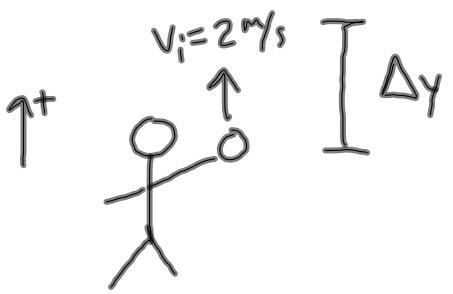
b) $v_{fy} = v_{iy} + a_g t$

$t = \dfrac{v_{fy} - v_{iy}}{a_g}$

$= \dfrac{-6.57\text{ m/s} - (-2\text{ m/s})}{-9.8\text{ m/s}^2}$

$= 0.467$ s

Jason now throws the volleyball upwards at 2 m/s from an initial height of 2 m.
a) How high does the volleyball travel?
b) How long does it take for the volleyball to reach its highest point?



$a_g = -9.8\ m/s^2$

$V_{fy} = \emptyset\ m/s$

Ball comes to momentary stop at top of flight

a) $V_{fy}^{\emptyset} = V_{iy}^2 + 2a_g\Delta y$

$$\Delta y = \frac{-V_{iy}^2}{2a_g}$$

$$= \frac{-(2\ m/s)^2}{2(-9.8\ m/s^2)}$$

$$= 0.204\ m$$

b) $V_{fy} = V_{iy} + a_g t$

$$t = \frac{V_{fy}^{\emptyset} - V_{iy}}{a_g}$$

$$= \frac{-2\ m/s}{-9.8\ m/s^2}$$

$$= 0.204\ s$$

Jason again throws the volleyball upwards at 2 m/s from 2 m. What is the total time that it takes for the ball to hit the ground?

Two ways to calculate:

1. One step with quadratic eqn.

2. Two steps: Calculate time to reach highest point, then time from highest point to the ground